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ABSTRACT

The Zimbabwe Secondary School Science Project (ZIM-SCI) developed student study guides, corresponding teaching guides, and science kits for a low-cost science course which could be taught during the first 2 years of secondary school without the aid of qualified teachers and conventional laboratories. This ZIM-SCI study guide presents activities and short experiments for a four-part unit which traces the path of energy found in food. Areas investigated include: (1) food chains and food webs (introducing producers, consumers, and decomposers); (2) organisms found in milk; (3) compost and fertilizers; (4) nature and identification of fats and proteins; (5) diets; (6) balanced meals; (7) energy measurement in joules; (8) digestive systems, focusing on the human system; and (9) anatomy and physiology of human teeth. Information is provided throughout the unit to help students understand the scientific concepts behind the activities and experiments. (JN)

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ZIM-SCI

ZIMBABWE SECONDARY SCHOOL SCIENCE PROJECT

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STUDY GUIDE UNIT G2

Living Things and their Food

SE043851

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UNIVERSITY OF ZIMBABWE
AND MINISTRY OF EDUCATION AND CULTURE

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FEBRUARY, 1983

ZIMBABWE SECONDARY SCHOOL SCIENCE PROJECT

GENERAL SCIENCE

STUDENTS: Please read this carefully. It will help you.

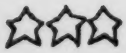
How you will study

This Study Guide comes to you with a kit of apparatus. Both things are part of a study programme leading you to an understanding of aspects of science. In this course you will be carrying out experiments. The Study Guide will help you to understand the scientific principles behind the experiments.

Your work should be done as you are instructed, either by the teacher or the Study Guide.

To help you to see quickly what you must do, the Study Guide uses these symbols:

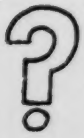
for "Read and revise your notes and Study Guide"



for "Take note of an important point that you should learn"

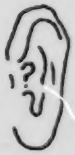
for "Summary. This is to help you to go over what you have learned"

for "Experiment"
When you see this sign, read the instructions carefully from beginning to end before you start to do the experiment.



for "How much do you know?"
This is for you, to help you to test whether you are remembering what is important.

for "Written work"
This is when you must answer questions in writing.



for "Listen to the teacher and do exactly what the teacher tells you to do"

for "Activity"
This symbol will appear whenever you are asked to do something without your apparatus.

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AIMS OF THIS UNIT

By the end of this unit you should be able to :

1. Identify organisms as producers, primary or secondary consumers.
2. Show how all organisms in building up their bodies form a food store for other organisms.
3. Write out a food chain using at least three named organisms showing how each depends on the other for food.
4. Link up several food chains occurring in one area to show a food web.
5. Describe how a pyramid of numbers shows that the transfer of energy from one organism to another is inefficient.
6. Describe what happens to all energy trapped by the sun.
7. Describe how minerals form a cycle in nature.
8. Name at least 3 animals which scavenge, 1 saprophyte, and draw 3 types of decomposer bacteria.
9. State why minerals are important to plants and animals.
10. Identify proteins and fats by test.
11. Describe the origin of proteins and their importance in plants and animals.
12. Describe the main importance of fats to animals
13. Work out a balanced diet for humans.
14. Analyse some foods.
15. Measure the energy content of foods.
16. Write a description of a Joule and a Kilojoule (unit of energy).
17. State why humans need animal type proteins.
18. Write a description of what happens to the various foods groups as they pass down the human gut.
19. Compare the digestive system of three animals including an invertebrate and a vertebrate .
20. Identify carnivores, herbivores,and omnivores by their teeth.
21. Identify your own teeth by name and by function.
22. Identify the feeding habits of three different types of insects by their mouthparts..
23. Demonstrate the effect decay bacteria have on teeth, and the advantages of cleaning teeth.
24. Discuss ways to help prevent decomposer bacteria,affecting food and drink and ,causing disease.

PART 1

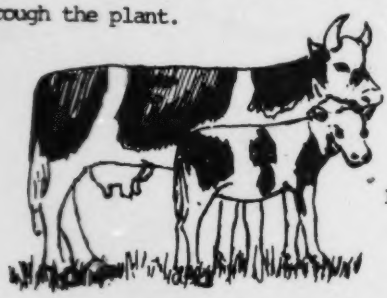
ENERGY PATHWAYS

In Unit G 1 you learnt that the energy from the Sun is trapped by plants, by photosynthesis, and stored in food. Plants produce the food used by all living things. Plants thus are known as PRODUCERS.

a producer

Plants can stay in one place, but animals need to move around to get their food and eat it by taking it into their bodies. They consume (eat) the products of photosynthesis, and are called CONSUMERS.

Many animals eat plants, either the green parts or the seeds, and get their food direct from the producer, such as a cow does. A cow gets the sun's energy in a stored form through the plant.

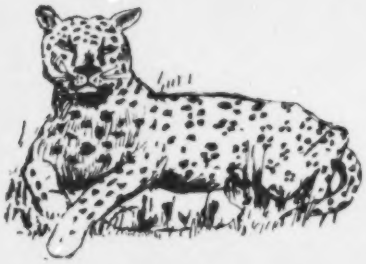


Primary Consumer

A leopard which preys on (kills and eats) a cow is also getting its energy from the sun, but in a less direct way. Some of the food made by the grass is used for a cow's life activities, but some is used for it to grow and is stored in the flesh. The leopard gets its energy second, after the cow. It is known as a secondary consumer. The cow gets its food direct or first from plants, so it is the primary (first) consumer.

3.

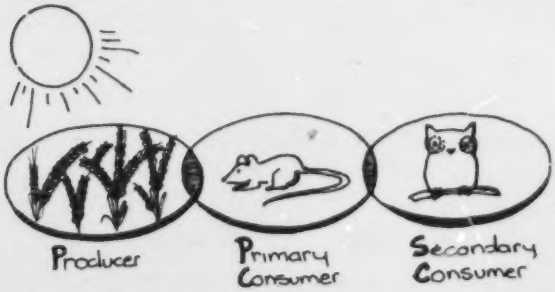
A Secondary Consumer



You can see that as some energy passes from one organism to another, each organism's life is linked to another's like the links of a chain, as in this picture diagram:

☆☆☆ This sort of diagram is known as a FOOD CHAIN

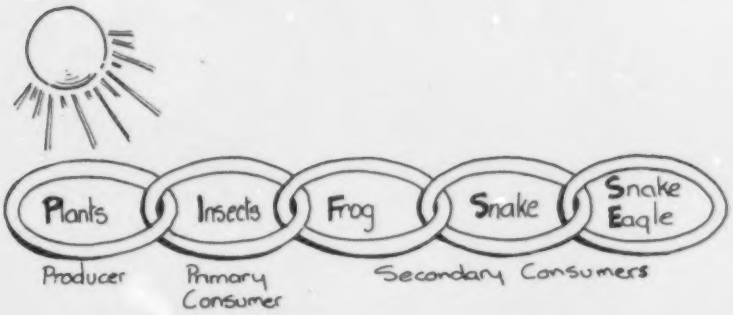
Food chains can be short like these two



one involving wild animals

and one involving ourselves

OR long like this one :



Food chains can be written in this way

grass ⟶ cow ⇢ leopard

grain ⟶ mouse ⟶ owl

grain ⟶ hen ⟶ man

The direction in which the food energy goes is shown by arrows.

5.

Here is a list of animals found in Zimbabwe, and what they eat.

PRIMARY CONSUMERS

NAME	WHAT IT EATS (Producers)
Hippo, mvuu imvubu	grass roots
Giraffe, furiramudenga intundla twiza idlulamithi	leaves
Reedbuck, Bimha Umziki	grass & leaves
Zebra, mbizi idube	grass
Dassies, mbira imbila	plants
Warthog, njiri ingulube yeyanga	roots bulbs plants
Rat, gonzo ingundwane	seeds & fruit
Impala mhara impala	grass & leaves
Hare, tsuro shuro umvundla	Plants & Grass
Cane rat, tsenzi ivondo	sugar cane grass reeds
Mouse, mbeva igundwane	seeds fruit
Squirrel, tsindi ubusinti indlegu	leaves fruit insects
Quelea birds, intakana	seeds
Locusts, hwiza intethe	plant leaves
Slugs & snails hozhwa honzwa	plant leaves
Millipede, zongorora chongololo	plant leaves
Birds, shiri inyoni bulbuls - queleas, weaver birds etc	seeds & fruit
Caterpillars, Madora macimbi	leaves
Duikers, mhembwe impunzi	leaves berries roots
Moles, nhuta imvukuzane (mole rat)	roots underground
Termites, (white ants) majuru ishwa	dry plants
Fish, hove inhlanzi	water plants

ANIMALS WHICH EAT PLANTS & OTHER ANIMALS & are both primary and secondary consumers

Baboons, bveni gudo indwangu	fruit berries insects & scorpions
Shrew, dune untswebe	snails earthworms fruit & vegetables
Bushpig, humba nguruve ingulungunda	plant material insects & eggs
Tortoise, kamba hamba ufudu	fruit, millipedes & snails

SECONDARY CONSUMERS

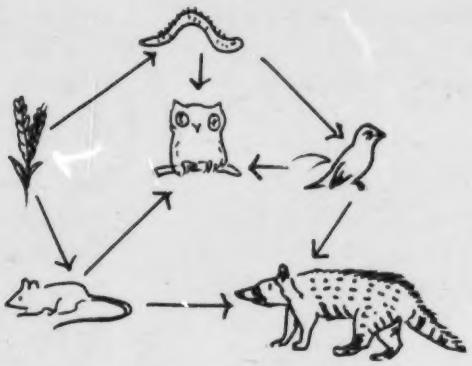
NAME	WHAT IT EATS
Mantis, mbuyambuya ucigo	other insects
Spiders, dandemutande isayobe	" "
Frogs & toads datya dafi amaxoxo	other insects
Wasps, igo ulonyovu	insects
Giant toads, dzetse idlamedhi	small birds mice frogs
Slug eating Snake, nyoka inyoka	Slugs
Scorpion, rize konga	spiders mice insects
Secretary bird, mukwasi	moles, wasps termites small mammals Snakes tortoise
Fish Eagles, kondo utebetebe	fish
Martial eagle, ukhozi	dassies squirrels birds
Leopard, mbada ngwe ingwe	dassies bushpig baboon impala reedbuck
Lion, shumba isilwane	zebra giraffe small buck
Civet	mice birds
Crocodiles, garwe ingwenya	birds large mammals such as buck, lion zebra
Lizards, (ma) dsvinyu	insects
Serval cat, nzudzi inhlozi igola	rats mice birds spiders
Cheetah, dindingwe ihlozi	impala reedbuck porcupine hares kudu
Jackal, gava Inkanka	rats mice lizards dung beetles spiders scorpion dead animals
Mongoose, govo chikovo isitsikibololo	earthworms frogs small reptiles insects larvae in soil
Glossy Starling, gwirokwo hwirokwiro ikhwezi	locusts worms grasshoppers
Grey heron, ngauzani itsheme	fish
Fish	insects, insect larvae and smaller fish

EXERCISE 1

In your note books you should write out at least three food chains, using organisms in this list and one food chain which includes yourself.

In life you can see that there are many food chains. You will find that they are not all separate. On your list you will have noticed that storks, civet cats and giant toads all eat frogs. Serval cats, secretary birds and eagles all eat small birds and so on.

Food chains often get tangled like this:



Take for instance in the grain---mouse--- owl chain. A caterpillar could eat the grain plant, and in turn be eaten by small birds. The owl will eat the small birds and the mouse, and the civet cat preys on mice and birds!

☆☆☆ The diagram begins to look a little like a spider's web, which is why it is know as a FOOD WEB.

In the rural areas of Zimbabwe the food webs of wild animals often become a nuisance to a farmer and his domestic animals.

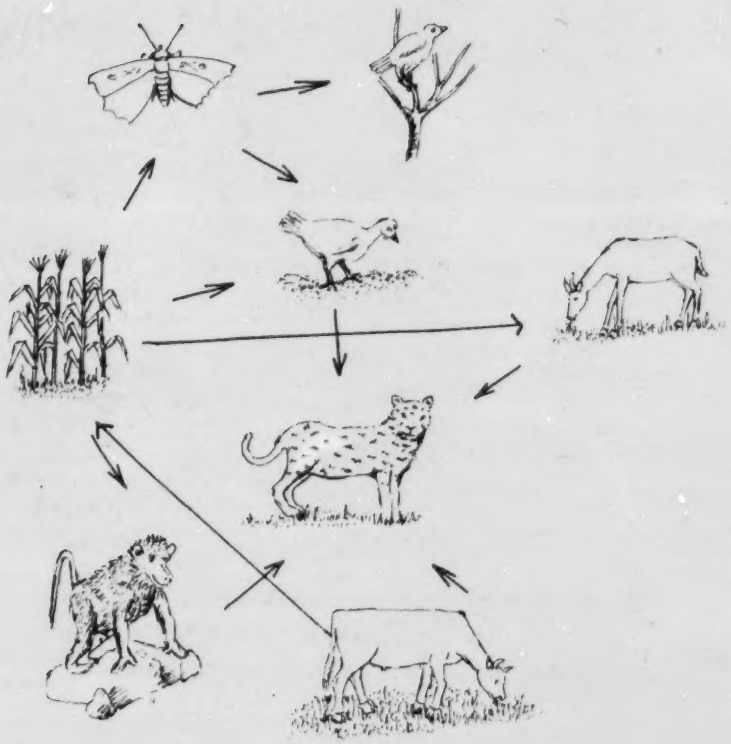
One of the first food chains shown was

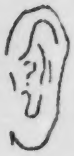
Grain ---→ Hen ---→ Human

But Insects or wild birds or baboons eat grain and a leopard would eat a hen or a baboon. Wild buck could come in and eat the cow's grain and the leopard could eat both animals.

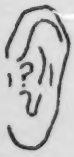
This is a food web which is of concern to farmers.

A food web of concern to farmers





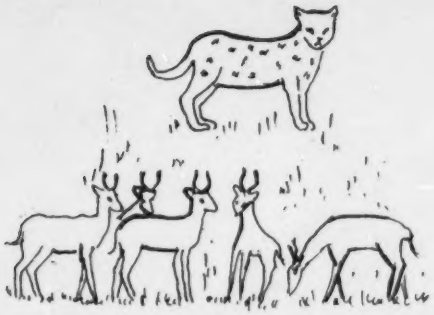
Discuss this with your teacher and the class and use your ideas and the information in the list to construct a food web on the blackboard for wild animals living near a river.



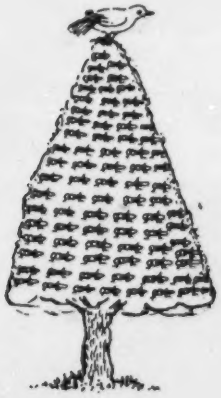
Discuss these next two pictures with your teacher. What conclusion can you reach from them?

9.

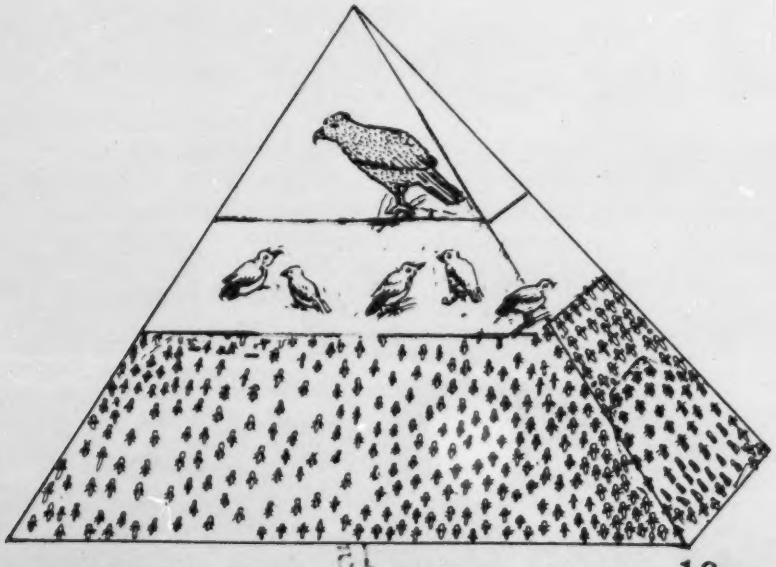
A leopard needs to eat four or five small antelope each month in order to live.

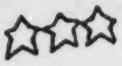


There are 80 grasshoppers eating the leaves of the bush. The glossy starling in the picture will eat all these in a day.



The next picture shows you that a hawk needs to eat 4 or 5 starlings a day because it is a big bird. You can now realise the large number of animals involved in feeding a hawk!





If you draw around them, a or PYRAMID shape is obtained. There are a large number of small organisms at the bottom or base of the pyramid and 1 animal at the top. This is know as a pyramid of numbers.

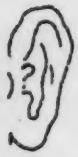
PYRAMID OF NUMBERS

In the "food pyramid" each organism depends on another for food. The whole thing can be thrown out of balance by conditions such as drought, wrong use of insecticides, or over grazing, or over hunting.

If there is a lot of grass available due to the plentiful rains, what effect will this have on the numbers of antelope in the area?

The antelope will grow fat and strong. Their babies will be well fed, and many will survive. There will then be more food for secondary consumers such as leopards. The leopards will also increase in number as their babies will be better fed and more will survive.

What happens if there is a drought some years later? There will be little grass. Some antelope will die, there will be fewer of them for the leopards to eat. The leopards may move away or die.



Now listen to your teacher.

SAVING ENERGY

In your lifetime you may earn quite a lot of money. Most of it you will spend on living expenses, such as food, clothing, fuel, transport and housing. Perhaps you will save a little to put in the bank, but that will only be a small amount compared to what you spent of all that money.

11.

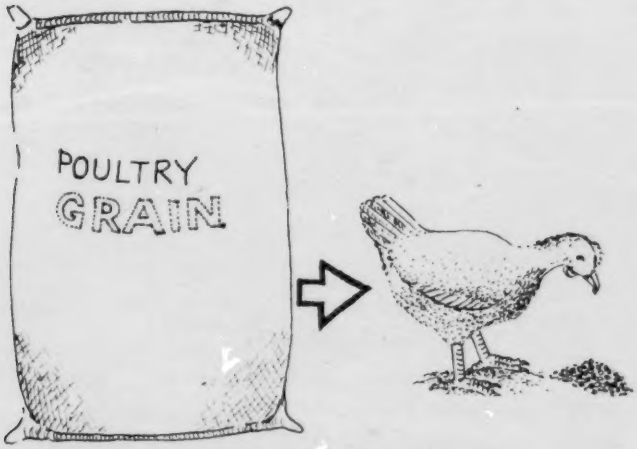
SPENDING

Similarly of all the food you consume, most will be converted to energy for living, working and playing and of course, a lot of energy is lost to the surroundings as heat. A small proportion of the food is saved in you as you grow and gain mass. This saved food of course contains stored energy in the form of your muscle or fat tissue.

SAVING

For instance:

A Chicken has to be fed 4 kg grain to increase 1 kg in mass



Here is an example of how much food a cheetah has to consume to get enough energy to live and grow.

In 1 month 1 cheetah with mass of 50 kg

EATS

5 Impala - each with a mass of 40 kg
Total mass = 200 kg

Each Impala eats 45 kg dry grass each month

Total = 225 kg .

BUT

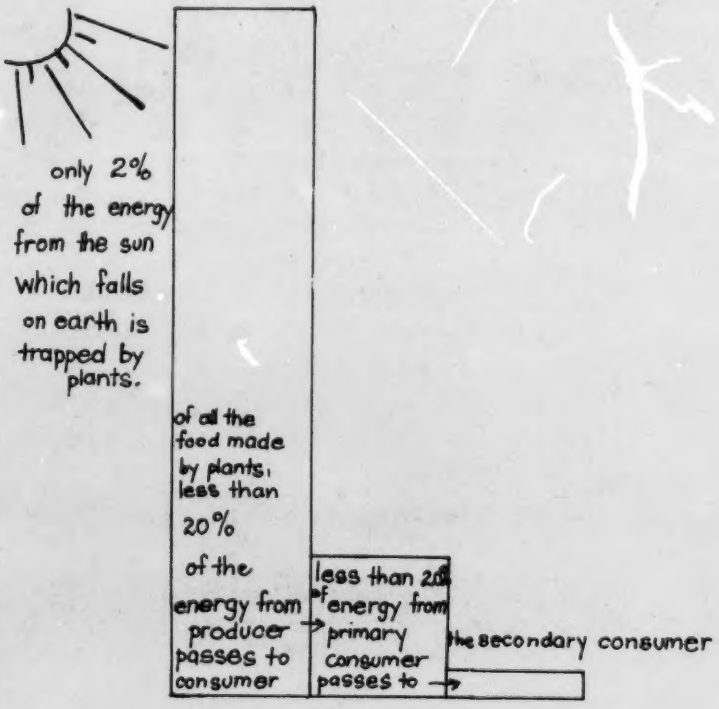
For each impala to reach a mass of 40 kg
it takes about 2 years (24 months)
So each impala has eaten 45 kgs grass
for 24 months = 1080 kg

But 5 impala have eaten 5 x 1080 kg = 5400 kg
of dry grass over the two years.

The cheetah has eaten in 1 month the product
of 5 400 kgs of food produced by the grass!

As those Impala only had a mass of 200 kg
5,200 kg of plant material has been lost,

It seems that the transfer of energy along a food chain is very inefficient. Plants have continually to be trapping energy. Animals have to continuously eat.

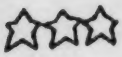

only 2% of the energy from the sun which falls on earth is trapped by plants.
of all the food made by plants, less than 20% of the energy from producer passes to consumer
less than 20% of energy from primary consumer passes to
the secondary consumer

What happens to the "left-overs"?

Not all plants and animals are killed and eaten by other animals. Many die naturally and fall to the ground. What happens to them? Some of the food that is eaten is not completely digested and falls to the ground in animal wastes or dung. If nothing happened to all material, the earth would soon be covered with litter and dung.
But dead plants and animals do not lie forever on the ground What happens to them? Some are eaten by other animals, others rot or DECAY.
What is "decay" ? You will be interested to watch it happen and find out what causes it.

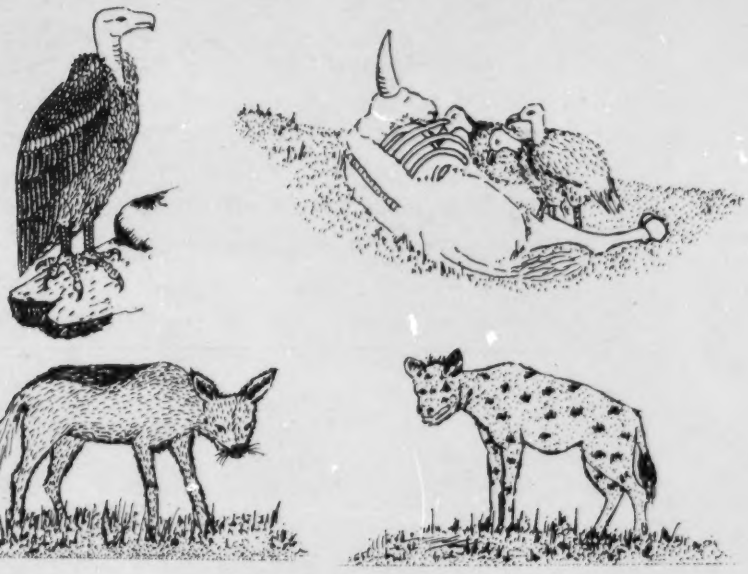
ACTIVITY 1 : Watching decay take place

Your teacher will show you 3 samples such as a dead fly, a piece of fruit and some stale bread or sadza in bottles. You will look at them at the start of each lesson for the next two weeks and observe the process of decay.
Copy down the chart your teacher will put on the board and record in it any changes you see happening to the samples.

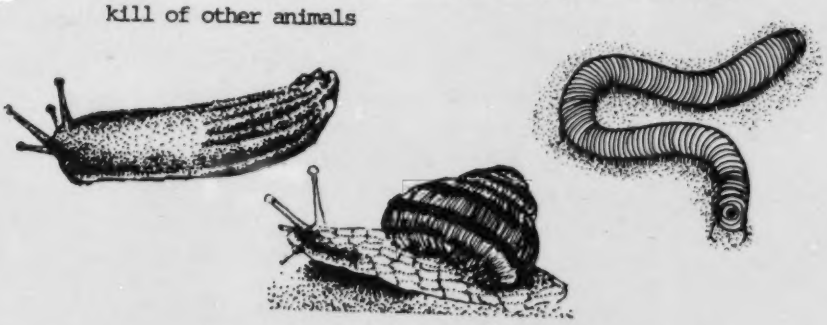


One of the first things you may observe is a visit to the fruit or bread by flies and ants, coming to feed Such animals, which eat up dead or "left-over "organisims are called SCAVENGERS

Here are some pictures of a few animals which SCAVENGE

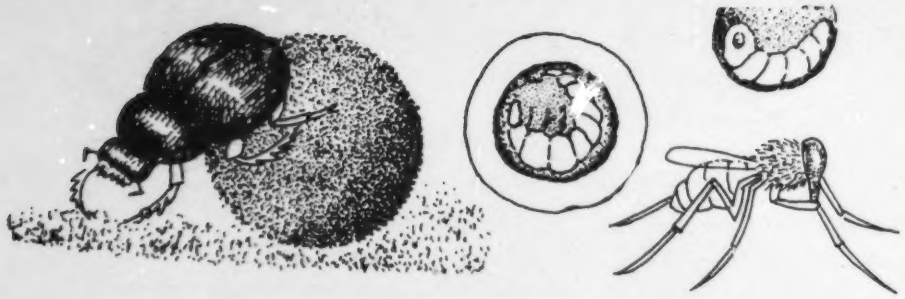


These animals will feed on what is left over from the kill of other animals



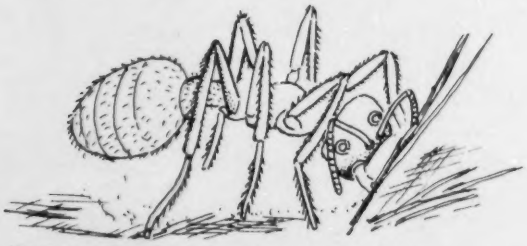
Slugs snails and millipedes can be found eating dead leaves old vegetable peels meat on old bones.

Termites can digest the tough cellulose of wood which few other animals can

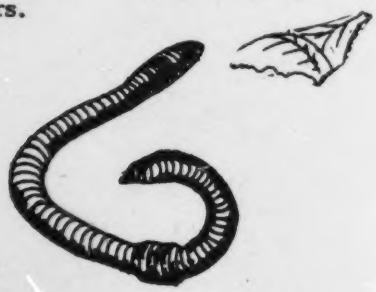


Dung beetles and flies often lay their eggs in dung so that their larvae may feed on it.

Ants will arrive quickly to eat dead insects



Harvester ants carrying dry plants cause losses to farmers.



Earthworms pull dead leaves into the soil.

A Wood louse lives in damp places such as under an old rotting log.

Go outside now and see if you can find some of these small scavengers.

Activity: 2

Looking for small scavengers

You will need

A strong stick

Plastic cup and lid

Tweezers/forceps

Spade or badza

Piece of paper

Look for scavengers in the following places by :-

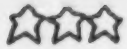
1) Scratching in the leaves under bushes or at the edge of a compost heap.
2) Digging over soft damp earth in the vegetable garden.
3) Using your stick to roll over an old log which has been lying on the ground. BE CAREFUL and do it slowly in case there are dangerous animals such as scorpions or centipedes underneath, they sting!
4) Opening up dung with your stick.

If you see any small animals try to observe what it has been eating, Then, using tweezers, pick it up and put it in your plastic cup

Take your SPECIMENS (samples) of small scavengers back to your class.

Exercise 2

Choose one animal, draw it and describe it.
Your class should place all the animals in a baby bath and make a list on the board of how many different scavengers were found, your teacher will then release them.
Make a key with your class using at least six animals.
Write it down in your book



By now your fruit,bread and fly will be starting to decay showing changes in appearance and smell.
The strange cotton wool like substance and different coloured powdery patches are, you may remember, strange plants.
They belong to a special plant group called FUNGI.
Fungi have no chlorophyll, so they cannot produce food, they have to get it ready made from other organisms . The fungi you can see consists of many threads. Some of these,like roots, are growing into the bread or fruit, to get food.

Your teacher will now give you some fungus to look at under the bioviewer.

Activity 3 - Looking at some fungus

You will need :-

Your bioviewer
A bio mount
A mounted needle or pin
Water
Dropper

Place one drop of water on your bio mount. Your teacher will give you a tiny piece of fungus plant, on your bio mount. Do not touch it with your fingers, but spread it out in the drop of water using your needle or pin.
Close the bio mount and look at it under the bio-viewer.

You may see threads with a dark bigger end. This dark end is the fruit of the fungus, containing the seed-like spores.

Draw what you see..

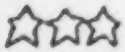
Your teacher may put one bio mount under the micro-scope for you to look at.

Sometimes, several different kinds of moulds grow on bread. If other pupils have a different mould to yours, go and look at it.

reproductive organ of a mould, containing spores (as seen under a microscope)

reproductive organ of a mushroom

A mushroom is the reproductive organ or fruit of another fungus which has many root like threads growing into the ground. These threads digest dead plants or humus in the ground. Plants which feed off dead material are called SAPROPHYTES.



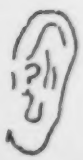
Are there any other organisms which cause decay?

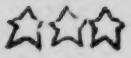
You are sure to have seen milk which has been kept too long and has "gone sour". It becomes thick and smelly.

When your fruit decayed, you noticed a change in smell and appearance too.

However, milk goes sour even if it has been covered to prevent ants or flies visiting it, and there are no fungi growing on it. Is it changing by itself or is something else which you cannot see causing it to decay?

You found that there were small organisms living in pond water which you could only see with a microscope. Do you think there are very small organisms living in milk and using it for food? What test would you use to give you a clue, that living things are present in the milk? Discuss this with your teacher .





The organisms which cause milk to sour are even smaller than paramecium or Euglena. They are called BACTERIA.

The one celled organisms in pond water, the bacteria in milk, and any other organisms which are too small to see except with the help of a microscope are usually referred to as MICRO-ORGANISMS.

You learnt in Unit F1 that, dead plants and animals rot and mix with the soil, to form humus. Humus comes originally from and was made by living organisms. When an organism grows it makes special substances such as cellulose and proteins to build up its body. Such substances whether present in dead or living organisms are called ORGANIC MATERIALS.

Therefore humus is organic material

What test did you think of using to find out if there were micro organisms in sour milk? Now use the same test on soil to find out if there are micro-organisms causing the organic material in the soil to decay. Go and fetch some soil to test in Experiment 1.

Experiment 1

Finding out about humus in the soil:

You will need:-

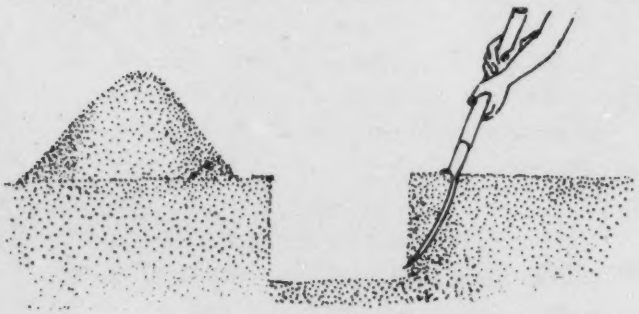
A bucket of water if the ground is too dry and hard to dig easily.

A spade or badza

A plastic bag

A sheet of paper.

Find some ground which has plenty of plants growing on it, or dead plants lying on it
Your school vegetable garden would be a good place.
Pour the bucket of water slowly on the spot.
Now dig a hole about 50cm x 50cm square and 20cm deep.
Using the spade, take a slice of soil from the side of the hole (see diagram) and place on your sheet of paper.

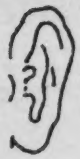


Spread it out and look at it. Do you see leaves which have been chewed by scavengers or have white threads of fungus growing on them? Ask your teacher to show you the leaf under the microscope

Remove any scavengers and take about two handfuls of soil back to your classroom in the plastic bag.

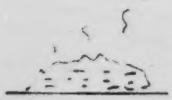
To test for the presence of micro- organisms.
You will need:
some thread
1 plastic bag
spatula/stirer
1 plastic cup
5ml water
1 plastic bottles quarter full of purple bicarbonate indicator

Give your teacher some of your soil



Half fill your plastic cup with the rest of your damp soil. Place it, and the bottle of indicator in the plastic bag. Tie it closed with a thread. Leave it in a warm place.

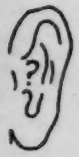
To find out if it is the living things in the soil which are causing the change in colour of the indicator, a control is needed. As living things are killed by too much heat, the best way to provide a control is to cook the soil! In this way, you will have all conditions the same except one. That one different condition will be the presence of micro-organisms. To save time the teacher will cook some soil for your class. It will then be treated in the same way as your sample, and labelled "Control".



At lunch time, or the next day come back and compare the colour of the indicator in your sample with that of the control.

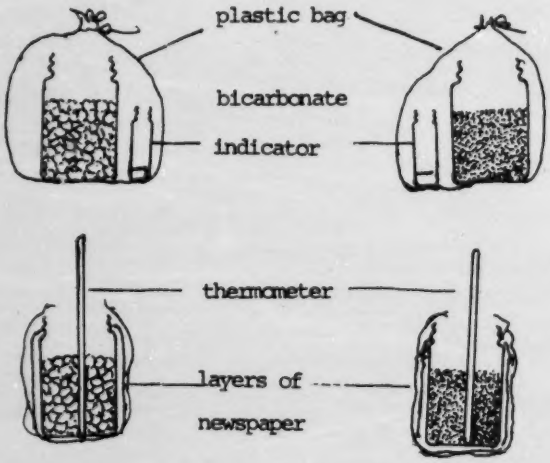
Now complete Exercise 3 .

When organic materials decay carbon dioxide is given off which is a clue that organisms are respiring.
Another clue that living things are respiring is when they give off heat.



Experiment 2 To find out if heat is given off during decay

Your teacher will have some cooked sadza, and some dry maize meal, you will be able to measure the temperature of the sadza as it decays and compare it with the temperature of the dry maize meal (which is the control).
Discuss this with your teacher.

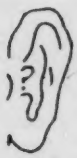


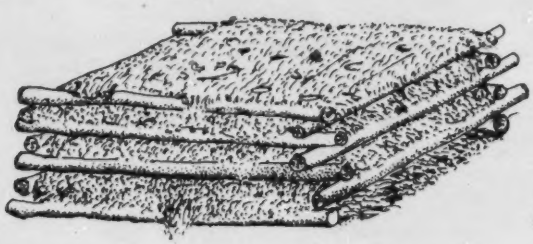
damp cooked maize meal

dry maize meal (control)

Now do Exercise 4

Humus is very valuable to us as it enables plants to grow better and improves the soil. It protects the soil from the force of rain which may make the surface of the soil so hard that no water can penetrate. It also keeps the grains of soil apart so that roots can grow in between them easily and water can run into the soil.
In nature the decay process is quite slow, so people try to make humus more quickly to put on their vegetable gardens.. Do you have a compost heap in your school garden? Discuss with your teacher the proper way to make a compost heap.
This picture may help you





If your school heap is decaying properly the micro- organisms should be giving off heat and carbon dioxide. Test it and see if decay is taking place. The most common reason for failure is lack of water. Why is water important?

EXPERIMENT 3

Investigating compost :

You will need -

a sheet of paper
small bottle with bicarbonate indicator
plastic bag or cup and lid
forceps
thermometer
a spade
spatula stirrer
pencil and book

First read the air temperature on your thermometer. Write it down in your book. Now use your spade to open a space in the compost heap, and push the thermometer into the space. Leave it in the heap for a few minutes. Then pull it out enough to read the temperature. Write this down too.

Take a spadeful of compost from the inside of the heap. Remove any small scavengers which you may see.

Why should you do this?

Do you see any leaves that have cotton wool like threads or powdery substance on them? Lastly put some the compost from which you have taken out any animals, in the plastic bag. Place the bottle with bicarbonate indicator in the bag too and tie up the bag. Leave it in the sun. Come back and look at the indicator later in the day. What do you see?

You found evidence of micro-organisms which are too small to see, respiring in soil, milk, compost heaps or decaying food. These micro-organisims are bacteria They are able to use up <u>all</u> the energy left in the dead organisms and waste products. (All the energy trapped by the plants is thus lost from the food chain. These final energy users are called DECOMPOSERS because they break up all the food which was <u>composed</u> or built up by green plants) Scavengers, fungi and bacteria exist at the end of any food chain.

Here is an example which you yourself saw:

Fruit ------> Fly --------> Fungus

and another which exists in nature

Grass --> Antelope --> Vulture --> Waste--->Bacteria

You will now be very interested to see more clearly what some of these decomposers look like.

ACTIVITY 4

Looking at very small organisms which break down dead organic material

Bioset ZS/3
Bioviewer
Look at slide 6. Read about it and draw a diagram.

Look at slide 7 and read about it.
Make a diagram of a pinhead full of spores.

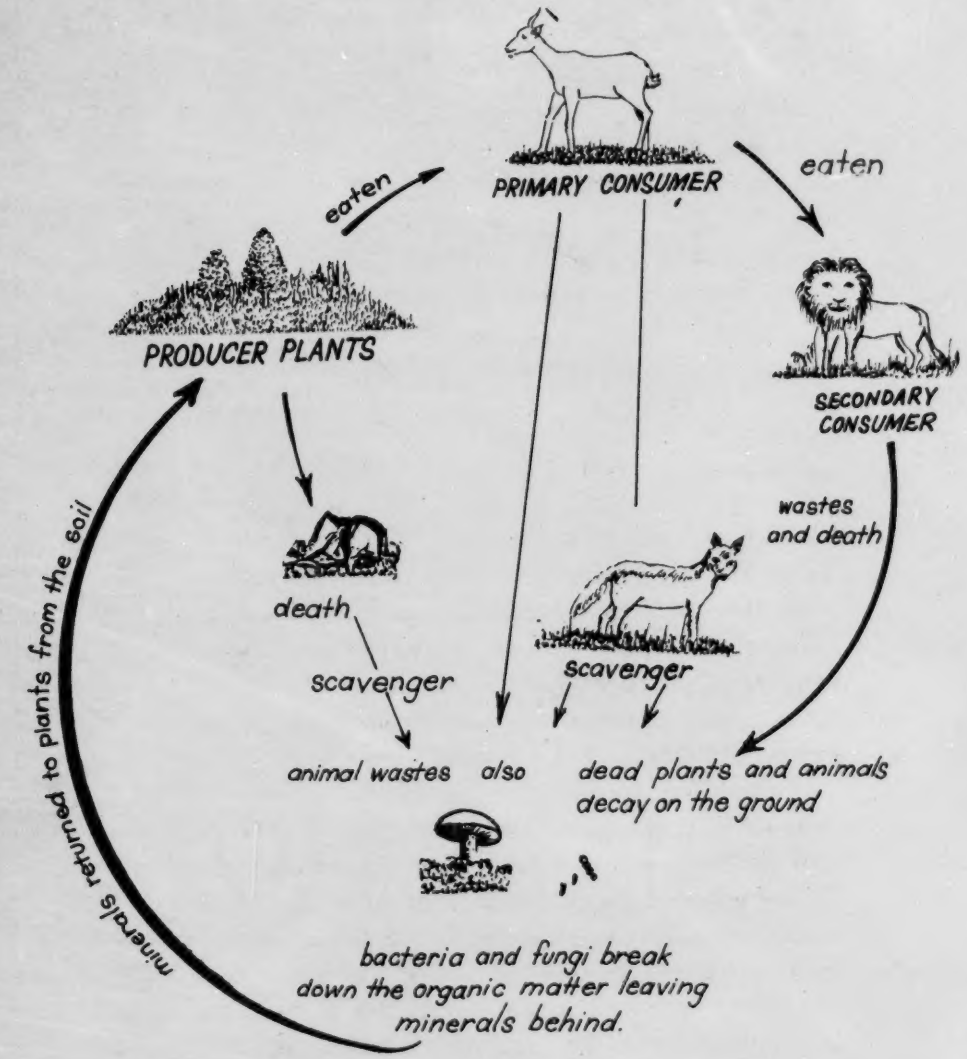
Look at slide 8, read about it, draw and label 3 different bacteria.

Now do exercise. 5

You have read that these organisms perform a useful job in cleaning the earth of excess organic matter which they break down so that green plants can use it again. But if these organisms are using up all the food material to get energy, what is left for the plants to use? What is the good of making compost, or putting manure on fields?

In order to grow strong, plants need minerals which they can only get from soil. Do you remember when Von Helmont measured the mass of soil in which his tree had been growing, he found there was a very small loss in mass? This was because the tree had removed something from the soil. Plants take up small quantities of chemicals called minerals through their roots. These minerals are built into their tissues, when the plant is eaten the mineral are passed onto the consumer. They are not lost, like energy, but stay in living organisms and their wastes. When the organism dies, scavengers and decomposers use up all the energy left in its body. These minerals are then returned to the earth for the plant to use over again in a natural cycle.

Here is a picture to show the cycle of minerals in nature.



Compost is made in order to return the minerals contained in the dead plants, to the soil. The decomposers work quickly if a compost heap is well made, watered, and turned to give air to the bacteria.

Good compost dug into soil improves it. The roots not only have a supply of minerals, but the soil is looser and the roots can grow more easily.

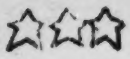
When a crop has been reaped, much plant material, such as the grain, is removed from the land to be eaten somewhere else. This means that some of the minerals are lost from the land each year. Only part of the plant, the stalk and leaves are ploughed back. Plants need these minerals in order to grow strong and each year they get less.

In order to make up for this loss of minerals some farmers use manure on their crop lands. While this works well, they should be careful that they are not upsetting the cycle of nature in their pastures where their cattle graze, by removing this manure to put on crops. Ordinary grass needs these minerals and so do the cattle!

How then can these important minerals be added back to the soil?

You may have seen the letters N.P. & K. on fertiliser bags.

These are symbols scientists use instead of writing out the chemical name.



N - stands for Nitrogen
P - stands for Phosphorous
K - stands for potassium

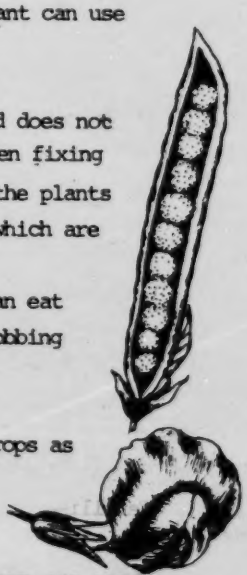
These letters tell us that the bag contains chemical fertiliser compounds with soluble nitrogen, phosphorous and potassium! These are the minerals most needed by plants.

The addition of the right amount of fertiliser at the right time gives a farmer greater yields from his crops.

Agricultural advisers in Zimbabwe help farmers by advising them on the correct use of fertilisers.

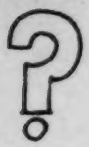
Plants cannot take in and use Nitrogen gas from the air. However, some bacteria can. These special bacteria that can take the gas nitrogen from the air and fix it into a form which a plant can use are called NITROGEN FIXING BACTERIA.

The plant uses this fixed nitrogen and does not need to get it from the soil. Nitrogen fixing bacteria live mainly in the roots of the plants belonging to the bean and pea family which are called legumes.
When a Legume crop is grown, people can eat protein rich beans and still not be robbing the soil of its nitrogen.



This is why it is good to grow such crops as peanuts, Russian beans and nyimo.

Now read and revise and answer, "How much do you know".



HOW MUCH DO YOU KNOW ?

1. Green plants are the _____ of food.

2. Living things which cannot photosynthesise have to get their food from other organisms. and are called _____.

3. Animals which eat other animals are called _____.

4. Animals which eat plants are _____

5. Animals which eat up dead organisms are called _____.

6. Plants which feed on dead organisms are called _____.

7. Fungi are non-_____ plants.

8. Bacteria are micro-organisms which finally break down food and are called _____.

9. The bodies of dead and living plants consist of _____ material.

10. Humus is the _____ in the soil. Compost and _____ add humus to soil.

11. Decomposers release _____ into the soil which plants can use to grow strong.

12. As every organism grows, its body becomes _____ which can be used by another organism.

13. Food is passed along through a number of organisms, each eating the previous link in the _____

14. _____ occur where several animals each eat a variety of foods. Some of these animals may eat the food also wanted by another animal.

15. A _____ shows that a large number of _____ consumers are needed to feed one _____

16. The letter N stands for _____

The letter P stands for _____

The letter K stands for _____

These are elements necessary to the growth of plants, and can be added to the soil as _____.

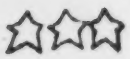
17. Beans and Pea plants belong to the _____ family which have _____ bacteria in their roots.

PART 11

FOOD GROUPS AND THEIR IMPORTANCE

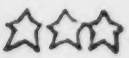
Why are minerals so important to plants?

PROTEINS



You know that a plant is made up of cells, which have cellulose walls. Cellulose is the main building material of plants. However, there is another important material within the cells of plants. That compound is PROTEIN (you have met this word before. Many of the foods we eat contain protein.)

As its nucleus, cytoplasm and enzymes are made largely of protein, the plant cannot carry on its life activities without this important material. Where does it get its proteins? The plant makes its proteins by adding elements such as nitrogen, phosphorous, sulphur, potassium, etc. to some carbohydrate molecules.



PROTEIN = carbon + hydrogen + oxygen + nitrogen and

sometimes sulphur, phosphorous, potassium, or others

The carbohydrate molecule is rearranged to include one or more extra elements. These extra elements are obtained by the plant from the minerals in the soil. In this way many different kinds of protein can be made.

ARE PROTEINS ALSO SO IMPORTANT TO ANIMALS ?

Animals do not have cell walls. Their main building material is the protein from which their cells are made. They also need proteins to form substances like enzymes which help carry out their life activities.

Just as there are different carbohydrates within the carbohydrate group, so there are different proteins in the protein group. For now we will divide these into two types

These are .

1. Plant type proteins - made by plants.
2. Animal type proteins, which make up animal tissues.

How do animals get their proteins ?

Primary consumers get their protein from plants. When they eat the plant type proteins, they are able to change it into animal type proteins, with which to build up their bodies.

Secondary consumers such as lions and eagles do not have the same ability to change plant type protein into animal type protein. They have to eat other animals to get this protein ready made.

People get some of their protein from the plants that they eat. However, they too cannot make the animal type proteins, so they have to get some from meat, eggs or milk.

There is a simple test by which you can detect the presence of protein. You can find it out now.

Experiment 4

A simple test for the presence of protein

You will need :-

from your teacher
Some protein liquid in your small beaker
An albustix

The albustix is similar to a clinistix, only it is pale yellow at the testing tip

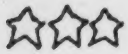
REMEMBER you must not touch the coloured end. Hold the stick by the transparent plastic end only.

Dip the stick in the liquid. Remove it and watch the colour change.

Answer Exercise 6 part 1

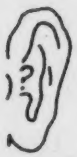
Another food group which plants and animals make from carbohydrates is the FATS.

(Do not be confused between fats and oils - they belong to the same group, but fats are solid at room temperature and oils are not)



FATS

In this group, the carbon, hydrogen and oxygen molecules have been rearranged and contain about twice as much energy than the same amount carbohydrate. Fats are the form in which animals store their energy, as animals cannot store starch. Some plants store energy as oil. Can you think of any which do this? Discuss this with your teacher.



There are many different types of fats in this group just as there are many different carbohydrates in the carbohydrate group.

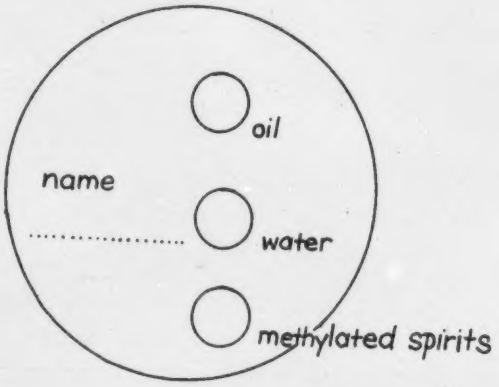
EXPERIMENT 5

A simple test for fats

You will need :-

Some oil or fat
a piece of filter paper
some water
some methylated spirits (meths)
a peg

Draw three circles on your filter paper each about as big as a 10 cent piece. Label the first one "water" the second one "fat" and the third one "meths" as in the diagram.



Write you name on the filter paper.

Using a dropper, place a drop of water in the circle marked "water", a drop of oil or rub in some warm fat in the "fat" circle and a drop of meths in the "meths" circle. Hold the filter paper up towards the light (a window). You should notice that more light comes through the circles than the rest of the paper. The three circles are now TRANSLUCENT.

Peg up the filter paper on the string which your teacher has put up in an warm, airy place.

After a while look at the paper again. What do you notice?

Check on the paper occasionally until you find that the water circle is dry. Then hold it up to the light. What do you see?

Answer Exercise 6 part 2

Now that you know how to test for the presence of starch, simple sugars, proteins and fat, you can test some foods to see what they contain.

Milk and ground nuts or peanut butter are valuable foods. Which food groups do they contain? You will test <u>one</u> of them to see either in experiment 6A or 6B

EXPERIMENT 6A

Testing a Food to find out which food groups it contains

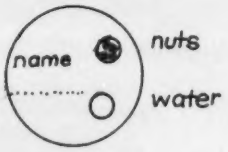
If your teacher gives you a sample of nuts, they will be crushed nuts or peanut butter.

You will need :-

Sample of nuts
filter paper
plastic beaker
water
an albustik
spatula/stirrer
some iodine

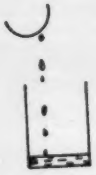
Copy down the chart for exercise 7A

1, First put ½ spatula of the ground-up nuts onto the filter paper. Press it down firmly with the spatula until a mark is left on the paper. Label it "NUTS"



2, Now put a drop of water on the piece of filter paper and label it "water". Place the filter paper outside to dry. What is the purpose of the drop of water on the paper?

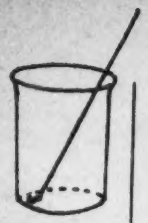
3, Scrape off all the remaining pieces of nut into your beaker add a few drops of water and stir well.



4, Use the albustik to test the mixture in the beaker. What colour does it become?

5 Add a drop of iodine to the mixture in the beaker. What is this test for? Does the iodine change colour ?

Answer Exercise 7 A



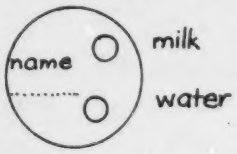
6B Your teacher may give you some milk to test instead of the nuts.

You will need :

A piece of filter paper (½ circle is enough)
A clinikstix
An albustix
A drop of iodine
2 ml of milk in your small beaker
White plastic lid

Copy down the chart for exercise 7B which the teacher will put on the board. Fill it in as you complete each test.

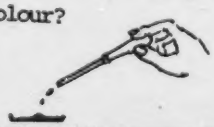
1, Place a drop of milk on the filter paper and label it "milk". Place a drop of water next to the milk and label it water. Put the paper in a suitable place to dry. What is the purpose of the drop of water?



2, Test with a clinistix. Note any colour change.

3. Test the milk with an albustix. Note any colour change.

4. Place a drop of milk on the white lid. Add a drop of iodine. Does the iodine change colour?



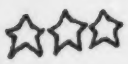
Answer Exercise 7 B

THE IMPORTANCE OF MINERALS TO ANIMALS

As well as the minerals in proteins, animals need minerals for other purposes, For instance :

Calcium and phosphorous which are used to build bones and teeth; salt is present in the liquid part of the blood and iron is in the red blood cells which carry oxygen around the body,

We eat quite a variety of foods to satisfy our needs. It is important that we have the right amounts of each type of food to have a balanced diet and keep healthy.



WHAT IS A BALANCED DIET?

Well, firstly diet is what a person eats each day. Balanced means the right kind of food in the right quantities. Let us look first at what a person needs:

1. Food for energy
2. Food to build the body
3. Substances to keep the body healthy

1. FOOD FOR ENERGY

In Unit G1 you learned that carbohydrates are the main energy food which people eat. They also eat carbohydrates in the greatest quantity. Thus the greater part of one's diet should consist of a carbohydrate. This could be a dish of cooked rice, potatoes or a loaf of bread. In Zimbabwe the carbohydrate most commonly eaten each day is sadza or isitshwala made from maize meal.

Fats provide concentrated energy. If a person does not use up all the energy food each day, both fats and carbohydrates can be stored in the human body as fat. This forms a useful reserve for the day when a person has no food, or he is ill.

2. FOOD TO BUILD BODIES

Proteins are the building material for animal tissues and we need to eat food containing proteins each day to grow and to replace worn out cells There are some plant type proteins present in maize meal, potatoes and flour, but these do not contain enough of the right proteins for us. We need some animal type proteins.

By eating other animals or their products, meat, fish, eggs or milk we get the necessary body building proteins.

Fortunately some plants do contain animal type proteins. Examples of these are nyimo, peanuts and beans which can be eaten in place of animal products.

ESSENTIAL EXTRAS

Minerals such as phosphorous, iron and salt must be present in the diet. They are obtained from eggs, meat, milk, fruit and vegetables and help build up our bodies and keep us healthy.

3. FOOD TO KEEP US HEALTHY

Contained in our diets there should be certain important substances called VITAMINS. These help prevent disease and are also obtained from fresh fruit and vegetables and certain animal products.

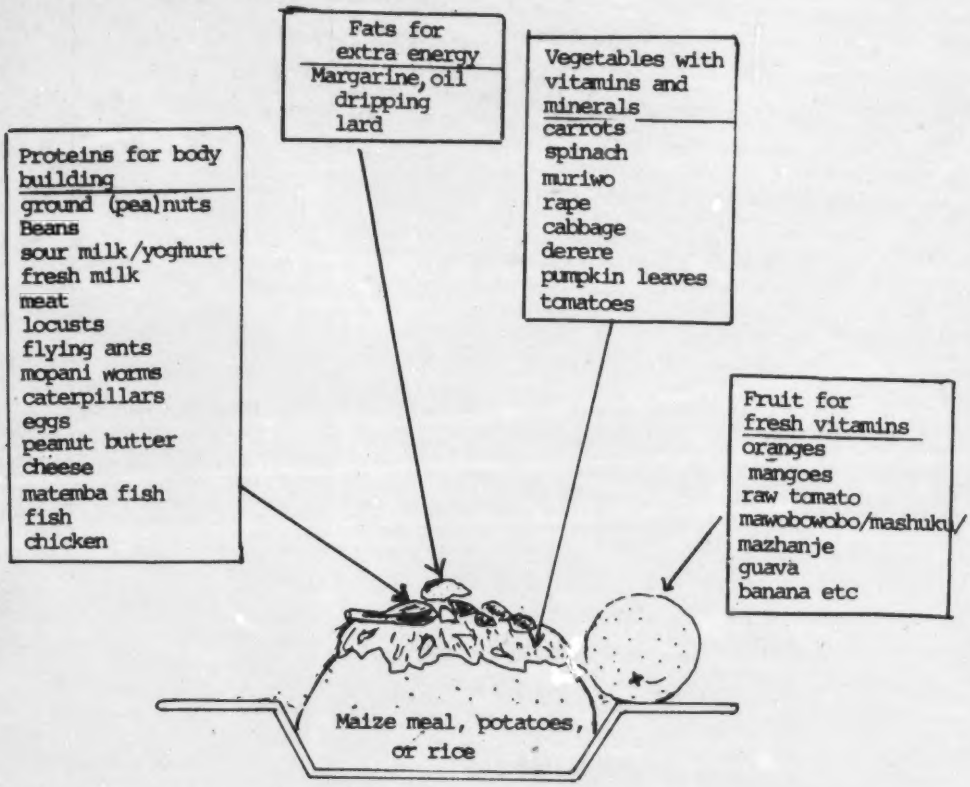
41.

Balancing Diet

If we start out cooking a pot of maize meal, potatoes or rice what sort of other foods should be prepared to make a balanced meal?

Look at the picture to see.

An example from each box should be added to the carbohydrate base.



As you can see, a person needs a lot of energy food, and some of the other foods, each day.

A good and tasty main meal would include, for instance:

sadza + meat cooked with oil + relish of rape and tomatoes + a banana
isitshwala

OR

potatoes + chicken + green peas or nyimo + an orange

OR

rice + fish + cabbage or rape + fresh tomato

OR

sadza + flying ants (ishwa) + pumpkin leaves + mawobowobo
isitshwala

Here are some examples of what makes up a balanced small meal to have before going to school, or a snack to take with you.

egg or sausage + cup of milk + an orange + toast and butter

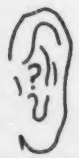
OR

cooked nyimo + banana + cooked mealies (mangayi, amagwadla) + peanuts

OR

Brown bread + margarine + peanut butter + apple

OR



brown bread & cheese + carrot + tomato + cucumber

Discuss with your teacher the purpose of each item in the meal. Now see if you can work out some balanced meals too in Exercise 8.

Carbohydrates only such as sweet drinks, maize meal and bread and jam do not make up a balanced diet.

What do you think happens if people eat far more energy food than they need?

The amount of each food is important.
Most of the meal should consist of carbohydrates, a smaller amount of protein and vegetables, and a little fat is ideal.

A diet of carbohydrate or fats only would not contain food for body building, or to keep you healthy. To eat proteins only would be wasteful.

A diet of only vegetables appears healthy, but would not contain enough energy or building material.

A diet of carbohydrate food only is totally unsatisfactory for growing children.

Babies which are no longer sucking their mothers milk may develop a disease called Kwashiorkor if fed only carbohydrates such as sweet potato, sadza, bread porridge, etc. as they cannot get enough protein, vitamins and minerals that they need from this sort of food.

Oil or fat as a high energy food, peanut butter which contains protein and fat cooked beans, and some animal protein such as an egg or meat should be given as well as porridge and milk in some form.

The sort of foods which a small child should be given are :

Oil or fat,
thin
porridge (bota/amanzi)
peanut butter
egg
meat
green vegetables (relish)
or fruit
milk (pasteurised or boiled)

Now do Exercise 9

Now you know what sort of food a person should eat each day, you should find out how much

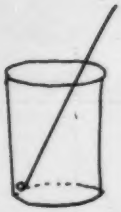
Firstly, how does one measure the amount of energy which is present in an energy food, such as a fat or carbohydrate?

You found that many foodstuffs burned, giving off heat energy. You could have used this energy to heat up water, as a wood fire does. If you had a measured mass of food you could find out how much it would heat up a measured volume of water.

You can do this experiment 7

Your teacher will have prepared a slip of paper for you, coated with 0,05g of mealie meal and will tell you how this was done.

You will need to measure the energy given off by an equal sized strip of plain paper so that, by subtraction you can measure the energy content of the mealie meal alone.



EXPERIMENT 7

To Measure the amount of energy in Mealie Meal

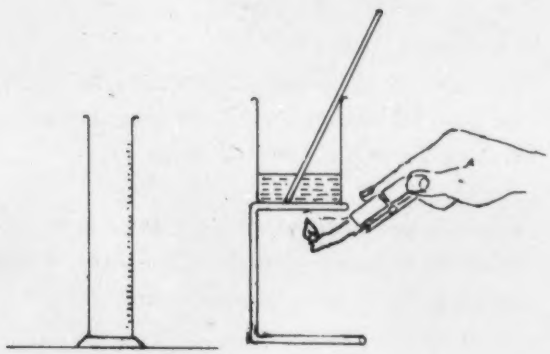
First copy down the exercise the teacher will give you :

You will need :-

Zim-Sci clock
a strip of plain paper
equal sized strip of paper with 0.05 g mealie meal

burner stand
matches
a peg
boiling tin
thermometer
50 ml water measured with a measuring cylinder

Put the water in the boiling tin and place it on the burner stand.
Take the temperature of the water. Write it down in the exercise 10 Fix the strip of plain paper in the peg by one corner. Light it and hold it immediately under the boiling tin. Allow it to burn completely. Stir the water in the tin for 15 seconds (timed by the Zim-Sci clock.)



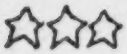
Now take the temperature again. Write it down in your exercise.

Throw away the water, and fetch another measured 50 ml of water. Take the temperature of the fresh water and write it down.

Fix the strip of "mealie meal" paper into your peg by a corner.

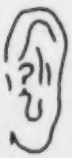
Light the mealie meal paper and hold it under your boiling tin until it has burnt out.

Stir the water again for 15 seconds and take the temperature. Record it in your exercise 10.



The heat energy from the burning strip is taken into the water. The molecules of water then move about more rapidly due to this extra energy. This extra kinetic energy is indicated as a rise on the thermometer.

The difference between the rise in temperature caused by burning the plain paper, and the paper plus mealie meal, will give you the rise in temperature caused by the energy in the mealie meal. Work out the r'se in temperature caused by the mealie meal (exercise 10)



This experiment was not very accurate. Can you think why? How could it be made more accurate?

You were told that fats contain much more energy than carbohydrates. You can test this statement by measuring the heat energy given off by 0.05 g of oil.

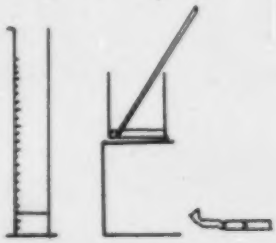
We have found the mass of three drops of cooking oil (the food you will use) to be 0.05g on our special balance. You must measure 50ml water carefully with the special measuring cylinder, and read your thermometer carefully to be as accurate as you can.

EXPERIMENT 8 To measure the amount of energy in oil

You will need:

Your boiling tin containing 50 ml water
(measured in a measuring cylinder)
burner stand
matches
a peg
2 strips of paper from your teacher
3 drops of oil from your teacher and a dropper

Write down the exercise your teacher will put on the board. Set up your apparatus as in the diagram.



Read the temperature of the water.
Write it down in your exercise 10

Holding a strip of paper at one end in your peg, light the other end. Quickly hold the burning paper underneath your tin of water allowing it to burn out completely.

Your partner should be stirring the water gently with the thermometer while the water is being heated. Then read the thermometer again after 15 seconds
Write down your thermometer reading

Throw out the water and put a fresh 50 ml of water in the tin. Now take up your second strip of paper, and place the 3 drops of oil along the strip, so that it spreads all through the paper. Read the water temperature with your thermometer again. Write it down.

Holding the one end of your oiled strip in a peg, light the other end and immediately hold the burning strip under your tin of water while your partner stirs it. When it has finished burning stir for 15 secs., read the temperature again and write it in your table.

The difference between the rise in temperature caused by the burning paper and the paper plus oil, will give you the rise in temperature caused by the energy in the oil.

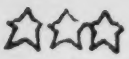
Work out the rise in temperature caused by the oil. Was the rise in temperature caused by the oil greater than that caused by the mealie meal?

Exercise 11

Work out how much mealie meal it would need to raise the temperature of 1 000 ml of water by 1°C.

Work out how much oil it would need to raise the temperature of 1 000 ml of water by 1 °C.

Scientists have a unit to measure energy.

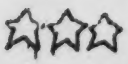


Energy is measured in JOULES.

Therefore, we measure heat, which is a form of energy in JOULES.

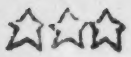
The more mass you have to heat, the more energy is needed.

The hotter you want to make the mass the more energy it needs.



Scientists have measured, and found that 4 200 Joules of energy are needed to heat 1 kg of water and raise the temperature by 1 °C.

A joule is a unit of energy, whether it is heat energy, light energy or work energy. The joules of energy in food can be used for Work, Life Processes or Heat. A Joule is a very small unit, so Biologists usually work in kilojoules which are each 1 000 joules.



The symbol used to write joule is J.
The symbol used to write kilojoule is kJ.

Scientists have worked out that a grown person needs about 7 100 kJ to carry out the daily life processes alone. Extra movement needs extra energy.

Here are some examples of how much energy is needed each day by different people.

EXAMPLE	Energy need per day
Young child	about 8 000 kJ
Housewife	about 11 000 kJ
Dressmaker	about 10 000 kJ
Male Office Worker	about 12 000 kJ
Farmer (digging or chopping wood)	Up to - 24 000 kJ

Now here are the amounts of energy contained in food groups

FOOD GROUP	POTENTIAL FOOD CONTENT
Pure carbohydrate	17 kJ per g
Pure fat	39 kJ per g
Protein	17 kJ per g

(Protein however is mainly used for body building not as an energy food)

How much body building food does a person need each day? A person needs about 80 g . of protein each day, half of which should be the special animal type protein.

100 g bread will contain about 2 g fat and 10 g protein. 100 g maize meal has about 9 g of protein too, but not enough of the right kind which is why a diet must contain some animal or bean protein.

EXERCISE 12

Taking (For the purpose of this exercise
Maize meal to contain about 16 kJ energy per g.

100 g meat as containing about 20 g fat and 20 g animal protein

1 g oil to contain 40 kJ energy

This will make your calculations simpler)

Work out the following :

(1) How much maize meal a farmer needs, to do a hard days work.

(2) How much meat that farmer needs to eat each day (if this were the only protein in his diet).

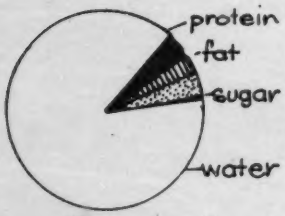
(3) If a quarter of a young childs energy need was supplied by oil, work out how much oil should be cooked with its meal.

You will have found out by testing some foods that a particular food often contains several food groups. You will be interested to see what is in some of the other foods we commonly eat.

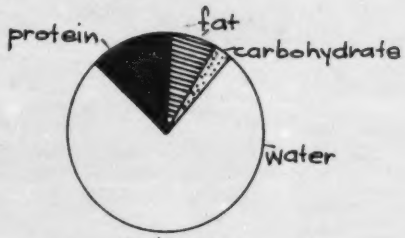
Some examples are given over the page. (The vitamin and mineral contents are so small that they cannot be shown on a pie chart.)

You will realise from the pie charts that working out a real balanced diet is very complicated

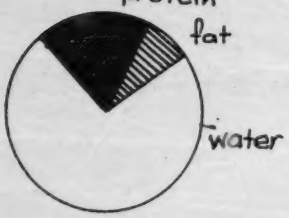
Here are some Pie Charts showing the quantities present of the different food groups in some common items in our diet.



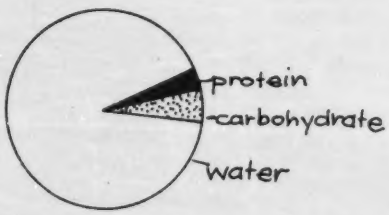
MILK (cow's)



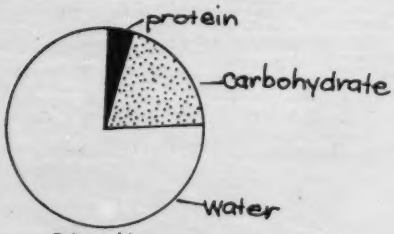
HEN'S EGG



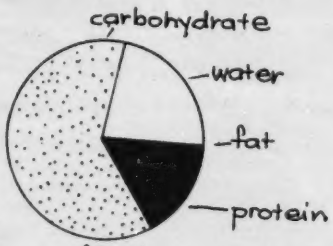
CHICKEN



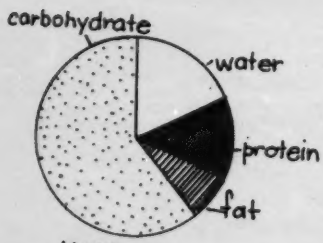
TOMATO



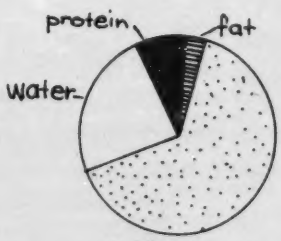
BANANA



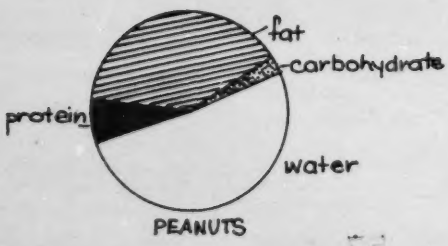
BEAN



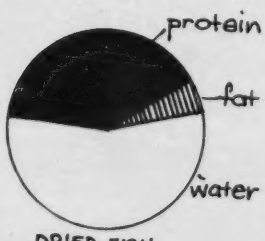
MAIZE MEAL



RICE



PEANUTS



DRIED FISH

Read and Revise and do How Much do you Know part II

How much do you know? PART II

1. The main building materials of _____ is cellulose.
2. The main building material in _____ is protein.
3. Primary consumers can use _____ protein to build their bodies.
4. Secondary consumers need _____ protein to build their bodies.
5. Proteins are built up from _____ with added _____.
6. A test for the presence of protein is when an _____ turns from _____ to _____.
7. Fats contain more _____than carbohydrates.
8. Fats leave a _____ _____ on filter paper.
9. A balanced diet means the right _____ of food is the right _____.
10. A balanced diet includes :-
    (a) Food for _____.
    (b) Food to _____.
    (c) Substances to keep the body _____.
11. _____ is measured in Joules.
12. 4 200 Joules are needed to heat _____ kg of water and raise the temperature by ____°C.

Write out in brief how the stored energy in food can be measured.

PART III

MORE ABOUT DIGESTION

Animals eat all sorts of food. Is the digestion system or gut difference in each animal according to it's diet?

Animals, as you know, show many external differences. Do their internal organs differ too? You will find out about this in the next activity. You will start with a very small animal.

ACTIVITY 5 Comparing digestive systems of several animals

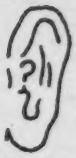
(1) You will need :
Bioviewer and Bioset No. JH 110

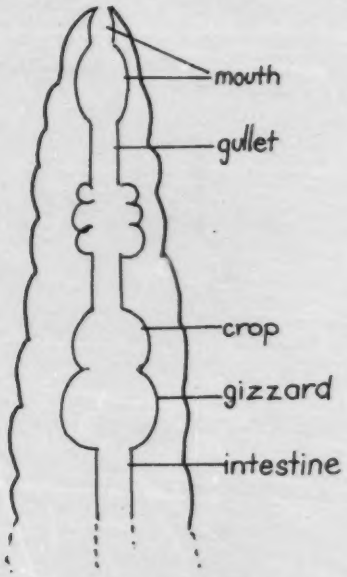
Look at slide 6, which is of Daphnia, sometimes called a water flea. It lives in pond water and many are only as big as the hole a pin makes in a piece of paper. You should notice that it has a very short tube (marked G inside of it), this is its gut. It is very simple.

Draw a simple diagram of a daphnia showing the gut. What do you think it feeds on in a pond?

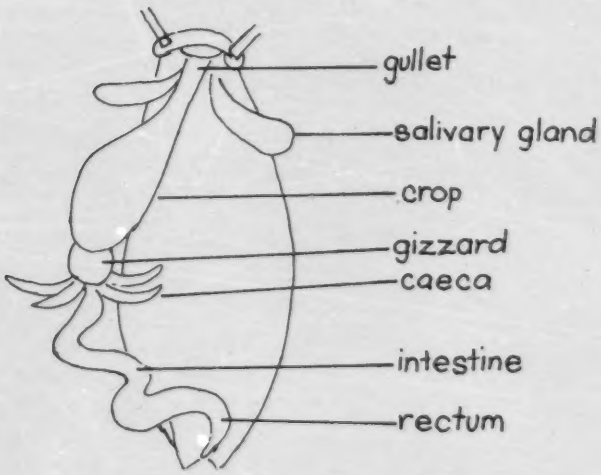
(2) Next you will look at the gut of a larger animal. Your teacher will cut open an earthworm or insect down its length. Can you see the tube which is its gut?

Look at the diagrams below to identify the different parts of the gut. Your teacher will show you the CROP and the GIZZARD and help you to find out about their functions. In what way is the gut of a worm or insect different to the gut of a water flea?

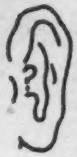




The Gut of an Earthworm.



The gut of a Cockroach

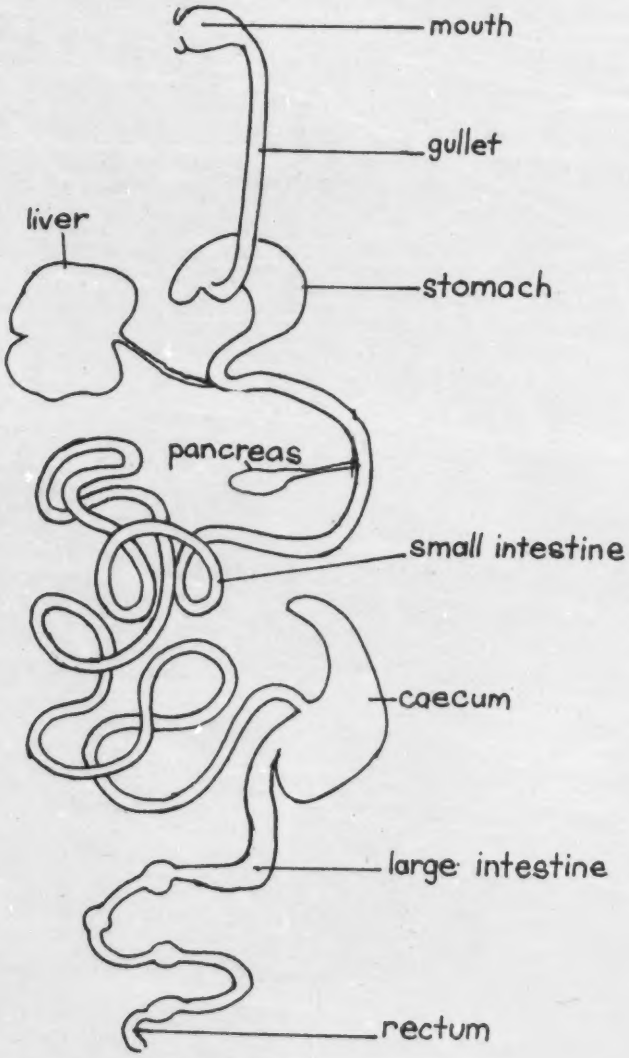


(3) You have probably already seen the gut of a rat, but your teacher will dissect one for you to study the different parts of it and learn their names.

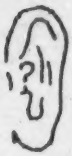
Here is a diagram to help you identify the parts.
How does it differ from the gut of :

(1) Daphnia?

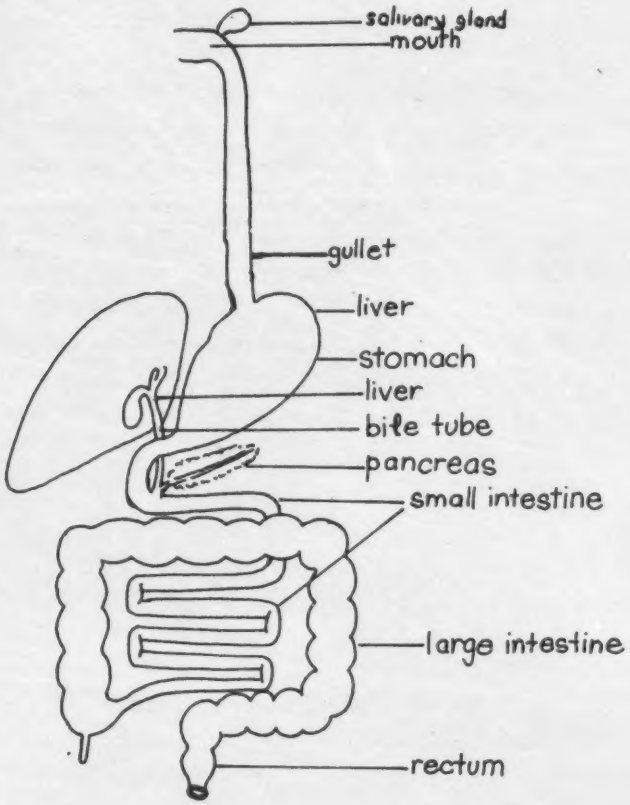
(2) An insect or worm?



Discuss this with your teacher and write a report in Exercise 13 .



Here is a diagram of the human gut. Look carefully and find the main difference between it and that of the rat or mouse you have just seen. Discuss with your teacher the difference in the intestine, and any difference you can think of in the diet of a mouse and a human diet.



THE HUMAN GUT

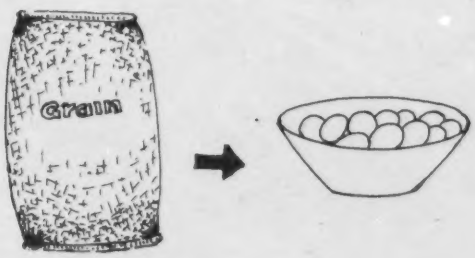
Where meat eating animals like ourselves have an appendix, plant eating animals have a large organ called a CAECUM.
This organ is necessary for the digestion of the cellulose which forms a large proportion of a plant eaters intake of food.

How can they digest cellulose and we cannot?

You will be amazed to learn that they make use of decomposers. The large caecum is the home of millions of micro-organisms, mostly bacteria. These organisms are special ones which do not harm the animal in which they live (called the HOST animal). In return for shelter and a ready food supply they break down tough plant material, turning it into minerals and proteins. The host animal absorbs these, and is able to build the protein of its own body.

Exercise 14 : A problem for you. On page 11 you read that, a chicken has to be fed 4 kg grain to increase 1 kg in mass. A hen needs about 3 kg grain in order to lay 12 eggs.
This seems to be a great waste of food! Why then do people bother to keep these animals to eat; why don't they just eat the grain instead?

Write down your answer to this question in exercise 14.



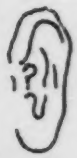
DIGESTING THE DIFFERENT FOOD GROUPS

You have learnt that we eat many types of foods - proteins and fats as well as carbohydrates.

In Unit G, you found that starch is broken down or digested by an enzyme in your saliva. The proteins and fats we eat also have to be broken down from large molecules to small molecules.

As food pases along the human gut, different enzymes are added to it. Some enzymes break down carbohydrates, some break down proteins and others act on fats.

Food is digested in a number of steps. The various food groups need different enzymes to break them down.

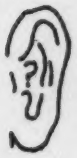


Look at your picture of the human gut while your teacher tells you what happens to the food in each part of the gut.

Now copy down the chart your teacher will put on the board

Then answer the exercise 15

Another characteristic by which we can describe an organism is its diet. We do not always have to watch an organism feed to find out abouts its diet. We can often tell by just looking at it. Animals have characteristic mouth parts, which are specialised for the job they have to do, which is getting hold of and eating the food.



Your own mouth, for instance, has a tongue to move food about and lips to keep food in your mouth. Most important are the jaws containing teeth. Listen to your teacher talk about teeth.

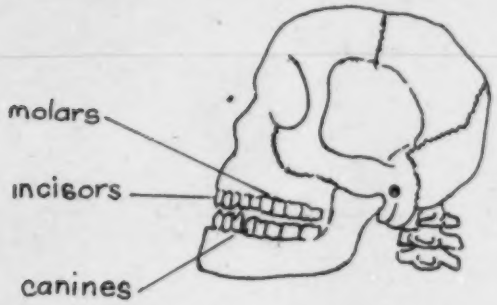
ACTIVITY: 6 Identifying your teeth

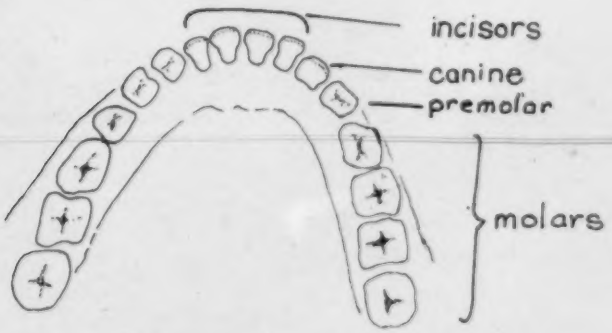
Open your mouths and look at each other's teeth. You can see that the front teeth are shaped like spades. They are called INCISORS and you have 8 of them.

Acting together they work like blades of scissors to cut off soft or crisp food - usually plant material.

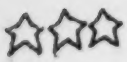
The "corner" teeth are a little longer and a bit pointed so that they get a grip on and tear off, tougher food such as meat. You have 4 of them and they are called CANINES. Behind the canines are cube-shaped teeth which have ridges. These are for grinding up the food and making it smaller. These grinding teeth are called MOLARS. You should have at least 16 molars.

Look at the side view picture of a person's teeth, and then the plan. Try to identify your incisors, canines and molars!





You may find that you have 4 less molars than in the plan. When you are a few years older they should appear.

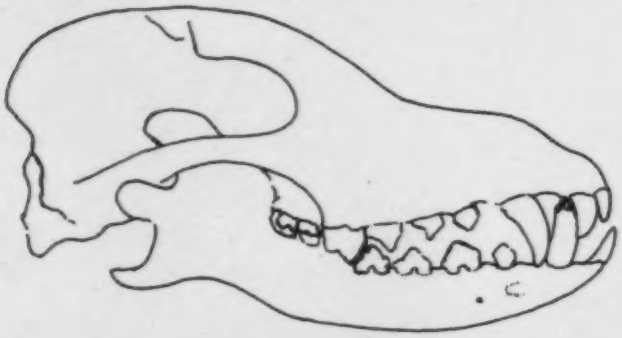


People eat plants and the flesh of animals. People are therefore classified as <u>OMNIVORES</u>. They have teeth to suit all kinds of food.

Look at the pictures of the skull of a dog and skull of a hare on the next page.

When you have examined them well, answer the questions underneath each picture in Exercise 16

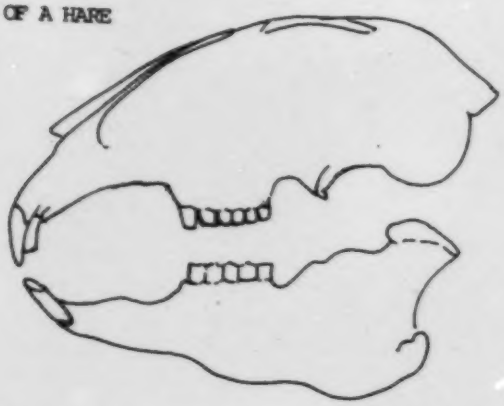
SKULL OF A DOG



Notice the small incisors and large canines.
Why do you think there is this difference in size?

A wild dog, a lion, a jackal - eat meat, and are called CARNIVORES

SKULL OF A HARE



Here is a picture of the teeth of a hare.
What do you see here?

Why do you think it has such big incisors?
Do you see any canines?

A hare eats only plant material, and it is classified as a HERBIVORE.

For your next lesson you will need to bring :

(1) A live grasshopper or locust.
(2) A live fly in a bottle.
(3) A dead mosquito.

GIVE THEM TO YOUR TEACHER.

ACTIVITY 7

Looking at insect mouth parts

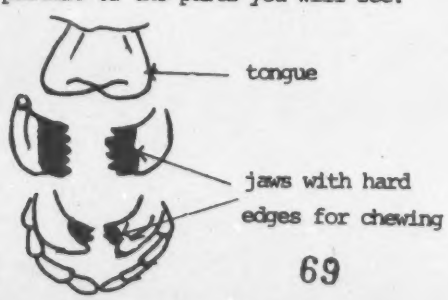
You will need :

Bioset ZS/3
Bioviewer
Insects (mosquito or fly)
Biomounts
Some sugar water from your teacher
A hand lens
White lid
Forceps

(a) To study the feeding method of a locust or grasshopper. First look at the bioset slide 1 and read about it.

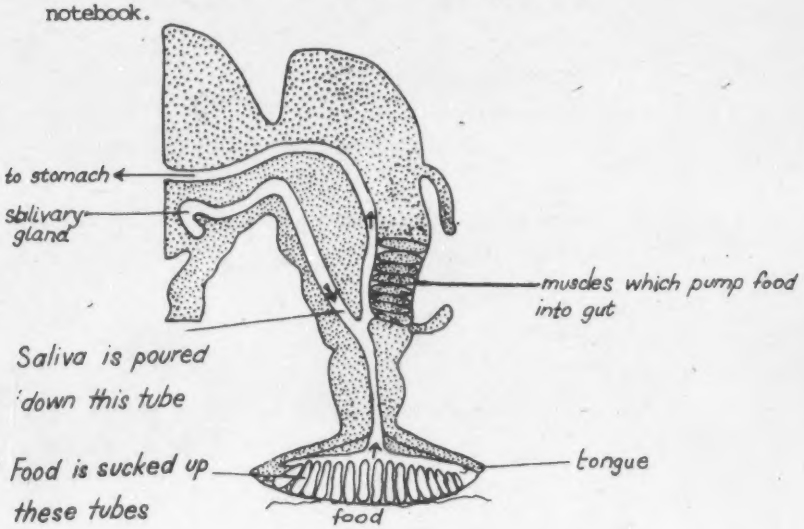
Your teacher will have some locusts in the insect cage. Put some fresh green grass or vegetable leaf in the insect cage. Watch the locust chewing using your hand lens.

Your teacher will have killed one grasshopper and pulled off its mouthparts for you to look at under a bioviewer.
Here is a picture of the parts you will see.



(b) To Study the feeding method of a Fly
Look at slide 2 and read about it. What sort of food have you seen flies feeding on?

Get a drop of sugar water on your white lid to observe the fly feeding. Follow the instructions in your Bioset.
This diagram shows the tubes inside the mouthparts of the fly. Copy it into your notebook.



(c) To Study the Mouthparts of a flea and a Mosquito.

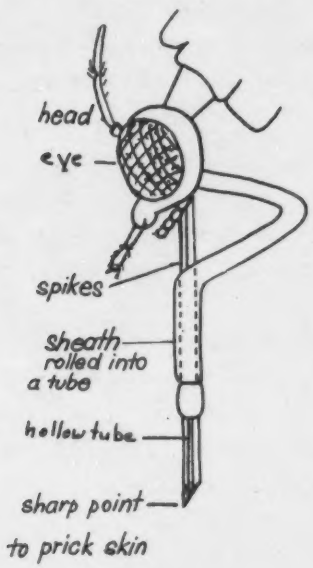
Some insects feed on the blood of other animals while they are alive. This sort of animal is called a PARASITE. Some examples are ticks, bedbugs, fleas and mosquitoes.

They all have to have mouthparts which can pierce or make a hole in the skin of animals such as ourselves. Then blood can be sucked up.

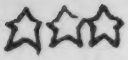
Study the sharp mouthparts of a flea on Slide 3.
Read about the habits of the flea and make a drawing of the head.

You will have brought a mosquito to school. Place it in a biomount, and look at it using your bioviewer.

A mosquito has a mouthpart which is rolled into a long thin tube and several sharp-spike like mouthparts. When the insect lands on a human, the sharp spikes prick a hole in the skin to get at the blood. So as to dilute this blood the mosquito pours in some of its own saliva. Blood and saliva are then sucked up through a thin hollow tube



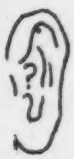
When not in use the sharp parts are kept inside the rolled up tube-like sheath, so when you look at your dead mosquito, you may not see all of them.



Animals which feed off other living animals are called PARASITES.

NOW DO EXERCISE 17

Some mosquitoes carry an unpleasant micro-organism in their saliva. When they bite us, this organism is transferred to us into our blood. Here it lives, reproduces fast until there are vast numbers feeding on our blood, and making us weak. Their waste products make us ill with a high fever. This micro-organism is called a parasite as it feeds on us while we are alive. You will know of it because it causes the disease MALARIA



Other unwelcome disease-causing parasites are carried by ticks. Can you think what they are?
Discuss them with your teacher.

Plants can get diseases too. A white powdery substance, or rusty red patches may appear on leaves.

These are probably the diseases called MILDEW or RUST, which are caused by fungi. These are parasitic fungi, which feed off the live plants and can do great damage to crops. Your teacher may have a plant to show you which has been affected by a parasitic fungus.

Read and revise, then do "How much do you know?" Part III.

How much do you know ? Part III

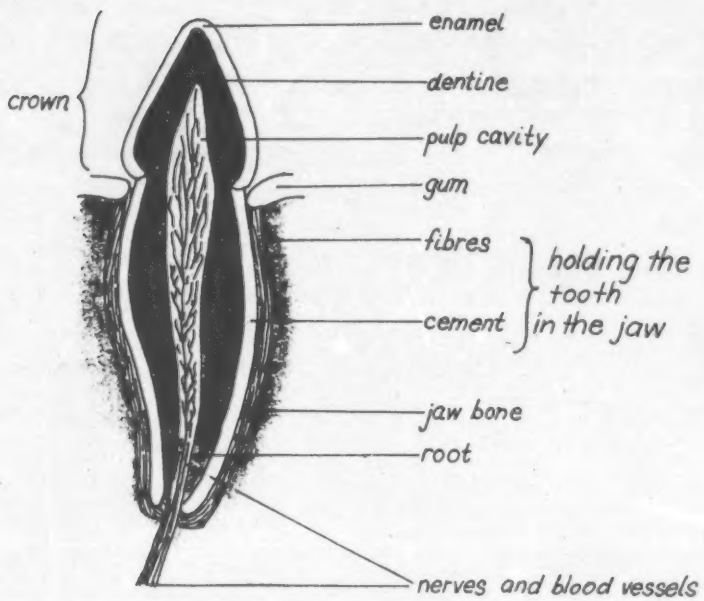
1. Daphnia has a _____ _____ gut.
2. The _____ of a _____or rat is many times longer than its body.
3. A herbivore has a special part to its gut called a _____. This enables it to change plant proteins to _____ due to the presence of special _____.
4. Herbivores have no _____ teeth, as they only eat _____.
5. Carnivores have special large _____ teeth to fight or kill other _____.
6. People are _____as they eat plants and animals.
7. A mosquito is a _____ as it feeds on living things.
8. A fly has _____ mouthparts.
9. A locust has _____ mouthparts.
10. The type of _____an animal has depends on its _____.

PART IV

HOW BACTERIA AFFECT YOU

Your teeth are important to you, so you need to keep them in good condition. Bad teeth can cause pain and interfere with eating, so you should learn about them and how to look after them.

A tooth is very hard and strong. It is made of a bone-like substance called DENTINE which is partly covered with a layer of the hardest material the body can which is ENAMEL



Here is a diagram of a tooth(cut through lengthways in the jawbone)

A tooth has a space inside it.

This is called the PULP CAVITY, which contains a nerve and blood vessels, as the tooth is a living thing and needs to be supplied with food and oxygen.

The tooth is held firmly in a socket or hole in the jawbone by special tissue. Only part of the tooth which sticks out from the gum has enamel on it. This part is called the CROWN

Many people use toothpaste on their teeth.
Do you remember the pH you recorded for toothpaste in Unit 2.
Is there any reason why toothpaste is basic?
Find out in experiment 9

EXPERIMENT 9

To Find out the Reason Why Toothpaste is Basic?

You will need :-

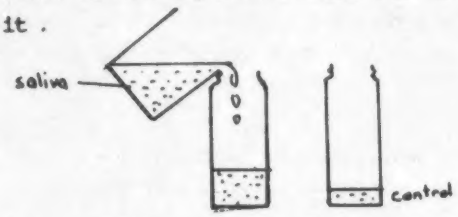
1 piece of universal indicator paper
beaker
spatula/stirrer
2 small bottles
2 ml measure
burner and stand
boiling tin three quarters full of water
thermometer
1 spatula glucose
1 spatula sugar

Put the water on to start warming up to 37 °C.

Copy down the chart the teacher will put up on the board.

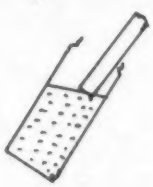
Place the sugar and glucose into your beaker.
Add 4ml water and stir until it has dissolved. Pour half the solution into each bottle.

Now you and your partner should spend ½ a minute swishing your saliva around your mouth and squeezing it through your teeth as often as you can. Then spit the saliva into the beaker, stir and add this to the first bottle Label it .



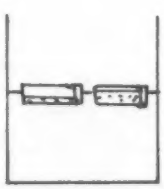
. Leave the second bottle containing only sugar water and label it number 2. This is the control.

Test the solution in both bottles with universal indicator paper, and record the ph on the chart.



Cap both bottles and float them in the water which should be at 37°C.

Leave in a warm place.



Test the pH again at lunchtime, or the next day.
Record the results on your chart.

What causes the acid to be formed ?
What effect does it have on your teeth ?

When you eat, your rather sticky saliva becomes mixed with food. Particularly if you have had sugary food, some of this mixture stays behind as a thin covering over your teeth, after you have swallowed.

In between your teeth, and where the teeth have grooves or dents, very small bacteria have an ideal place in which to live, as this sugary covering provides food for them. You have decomposers in your mouth! When they respire they give off waste products. These wastes are acidic as you have discovered.

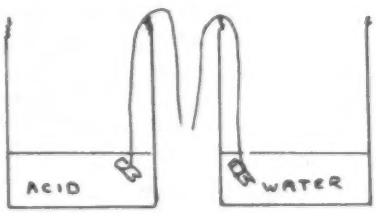
You know acid can burn your skin or clothes. What does acid do to a tooth? The acids in your mouth are not very strong so in order to see results more quickly, your teacher will put a tooth into hydrochloric acid.

See what happens to it in the EXPERIMENT.

EXPERIMENT 10

To see what effect Acid has on a Tooth

Your teacher will have two teeth The teeth will be passed around for you to look at. One tooth will be left in water to act as a control. The other will then be left in a beaker of hydrochloric acid for several days. Look at it each lesson.



Scratch the exposed part with a pin. Does it still feel hard? (Compare the control tooth with the one which was left in the acid). What do you notice?

Whenever and wherever a sugary covering is present on your teeth the bacteria will produce acid. This acid slowly reacts with the enamel until a hole is made. The acid continues to react with the softer dentine, until a hole reaches right through to the pulp cavity where the nerve is affected and you start to feel pain and you get a toothache.

HOW TO PREVENT TOOTH DECAY

Discuss your ideas with your teacher on how to solve these three problems:

(1) Food tends to stay in spaces between teeth.
(2) Sugary foods are most favourable to the bacteria.
(3) Acids produced react with the enamel.

Then do EXERCISE 18

Write down three ways to keep teeth from decaying.

DECOMPOSER BACTERIA AND YOUR HEALTH

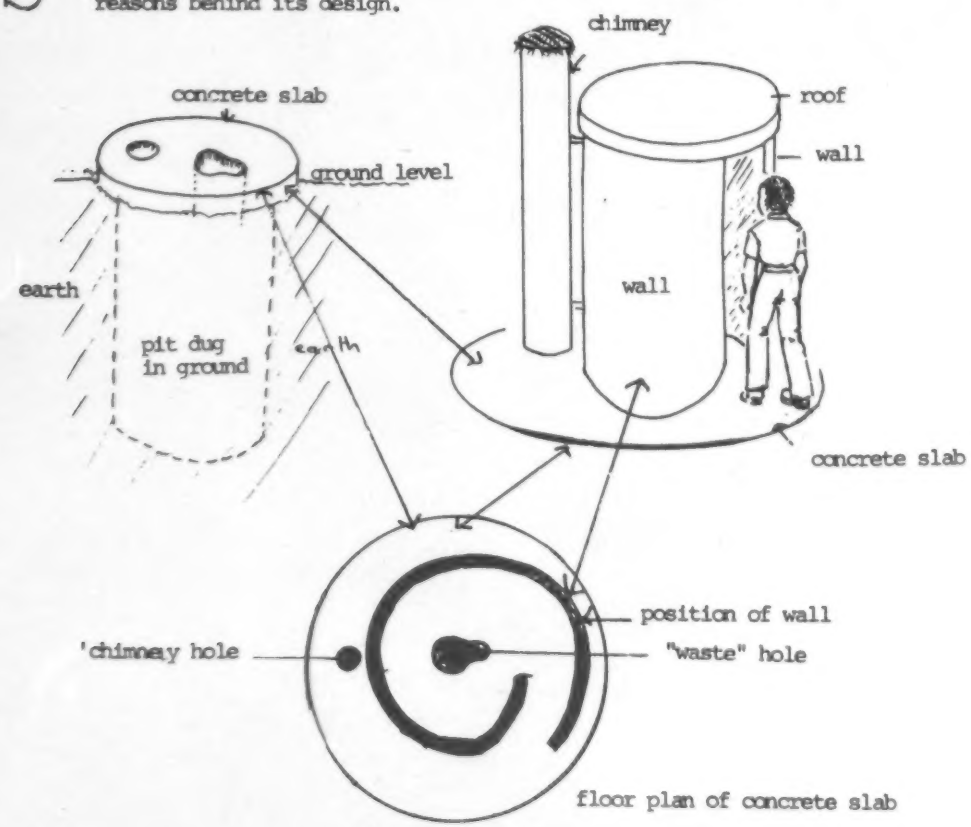
You have already seen that flies are scavengers which feed on all sorts of rubbish. They will also eat your food if they can. However, if they have been on waste such as dung, which is full of bacterial decomposers, they will carry away some on their hairy legs, or on the end of their feeding tubes. When they settle on your food, these bacteria are transferred to the food and they will begin to decompose it! The food you eat becomes infected with bacteria which can make you sick.

Think of all the places where flies may breed, and how to prevent them breeding there. Also how to prevent them getting to your food. Discuss your ideas with your teacher.

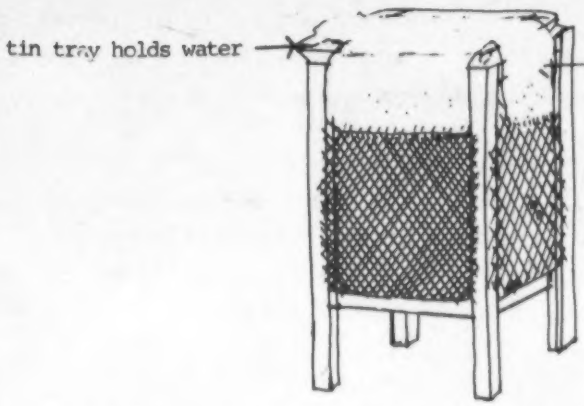
Bacteria and other micro-organisms of decay can get into our food and drink in other ways. Discuss these with your teacher too.

A baby is more easily affected by these disease organisms than an adult. A breast fed baby gets its milk direct from the mother and bacteria do not have the chance of getting into that milk! Discuss with your teacher the dangers if a baby has to be bottle fed, and when it stops being breastfed (that is when it is weaned).

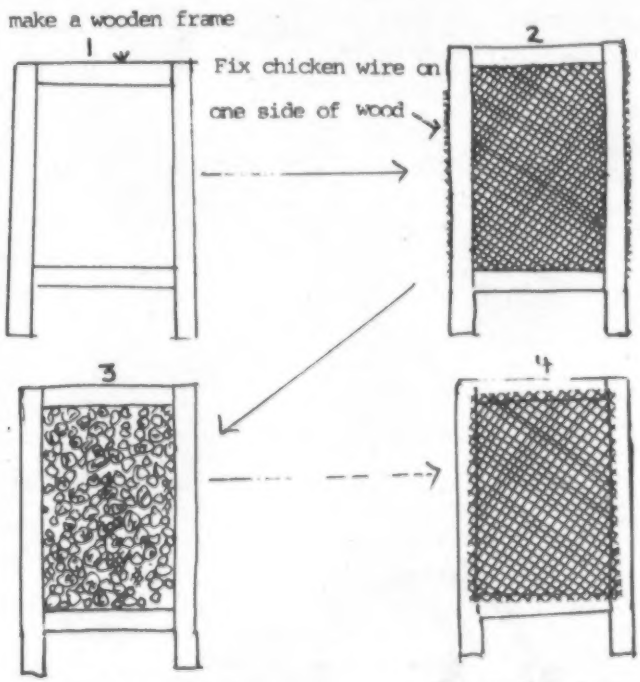
Here are pictures of a Blair toilet . Your teacher will explain how this helps prevent the spread of disease where there is no water borne sewerage. You will be interested in the scientific reasons behind its design.



Here is a picture of a "meat safe". Your teacher will explain the scientific reasons why it can help keep food cool and fresh. Can you think of anything else that uses this scientific way of keeping water cool?



If you want to know how to make a safe your teacher will explain these pictures to you.



place a layer of charcoal or old mealie cobs spread over the wire

Fix another layer of chicken wire over the charcoal to hold it in

The safe has 3 sides and a door, also a top and a bottom.

The top and bottom should be made in the same way as the sides. That is from 2 layers of chicken wire enclosing some charcoal. A shallow tin tray should be placed on top of the safe and kept filled with water.

A piece of sacking or old towel lying in the water, with the ends hanging over the sides of the safe enables water to continually flow into the charcoal of the safe.

Something to do

Find a piece of charcoal, and a stone of a similar size. Wet both, and place them on a windowsill. Feel them both half an hour later.

Now read and revise and do How Much do you know (part IV)

How much do you Know (Part IV)

(1) A tooth is made of bone-like _____, and the crown is covered with hard _____.
(2) The pulp cavity contains _____ and _____.
(3) The tooth is held in the jawbone by special tissue consisting of _____ and _____.
(4) Bacteria living in the _____on the teeth produce _____ which react with the _____ of the tooth.
(5) Toothpaste contains _____ which _____ the acid from the _____.
(6) Decomposer bacteria also cause our food to _____.
(7) Flies and dirt must be prevented from getting into our _____ and _____.

SUMMARY

The energy in food passes along a food chain from producers to primary and secondary consumers. In nature food chains may become related and form food webs.

The large number of primary consumers needed to feed secondary consumers form a pyramid of numbers. The energy within an organism is finally used up from the food chain by scavengers and decomposers and minerals are returned to the soil.

A cycle of minerals exists in nature as elements are continually re-used. When the natural cycle of these elements is changed by man, the correct use of certain crops and fertilizers can help prevent damage to the land.

Fats can be built up from carbohydrates.

Minerals are essential for the building of protein units from carbohydrates.

The presence of fats and proteins can be shown by tests. A balanced diet, with the right amounts of carbohydrate, fat and protein foods is necessary for growth and health.

Digestion of food starts in the mouth. Animals have mouthparts which suit their diet. Mammals have teeth to grind, cut off or chew their food. Insects may have sucking, piercing, or chewing mouthparts.
Animals have digestive systems which depend on both their diet and size.

As food passes along the digestive system various enzymes are poured onto it from the different glands which make them, at different stages.
Each enzyme is specific, acting only on one type of food group, breaking down the large molecules into smaller ones.

Decomposer bacteria cause disease if they get into food. Steps can be taken to prevent this.

Cleaning teeth regularly helps prevent acid wastes from bacteria, decaying our teeth.

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